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FEEDING AND MANAGEMENT OF GROWING-FINISHING PIGS

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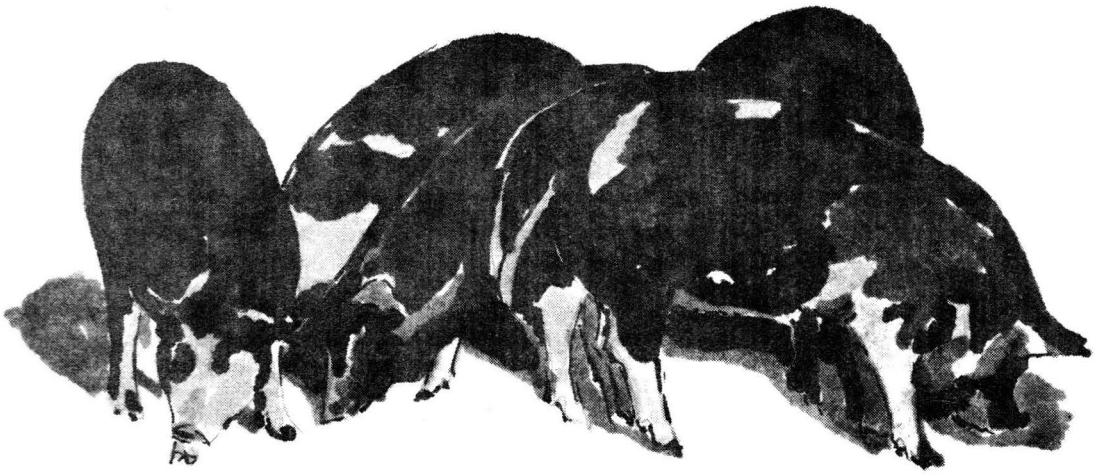

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Although pigs have passed the critical period by the time they weigh 50 pounds, sound management and feeding practices are still essential to obtain fast, efficient gains to market weight and to produce a quality carcass.

NUTRITION-FEEDING PRACTICES

During the growing-finishing period, feed represents a major item of expense. The feeding program should be directed toward producing the maximum amount of lean meat in as short a time as possible at the lowest cost per pound of gain. Knowledge of the general development of the pig helps in planning the feeding program.

At birth, the pig has a proportionately large amount of skeleton and body surface in relation to its weight. The rate of muscle formation in the pig increases from birth up to about 16 weeks of age and then declines. As the pig grows larger, proportionately more fat than lean is produced. The ratio of fat-to-lean increase in the full-fed pig varies from about 2:1 at 100 pounds to 3:1 at 200 pounds. About four times as much feed is required to produce a pound of fat as compared to a pound of lean meat. Thus, the pig becomes less efficient as its weight increases. Daily growth rate tends to increase up to 200 to 225 pounds and then declines.

During the early life of the pig, protein quality and quantity and high energy value in the ration are most important. It has been shown that protein quality of a feed affects the rate and size of muscle development in the pig. Pigs should be fed at a level producing the maximum rate of growth during the earlier stages when muscle rather than fat is being produced. Thus, a high plane of nutrition should be continued up to 100 to 125 pounds live weight. After this weight, bulkier, lower-quality feeds may be introduced in increasing amounts if the feed cost justifies it. Some restriction may be practiced to prevent excessive fat development in the heavier pig.

NUTRIENT REQUIREMENTS

Feed is required for maintenance as well as for growth of the animal. The amount of feed available for a given rate of growth depends upon that proportion needed for maintaining body functions.

Maintenance standards vary slightly for different climates and under different rearing systems. Feeding standards or requirements for growing-finishing pigs should be based on weight rather than on age. In terms of daily requirements, the total nutrient requirements increase with weight. However, in terms of percent composition of the ration, the nutrient requirements decrease since the animal consumes more feed. The nutrient requirements for different stages of growth are given in Tables 1, 2, and 3.

SAMPLE RATIONS FOR GROWING-FINISHING SWINE IN CONFINEMENT

Generally, pigs raised in confinement need additional nutrient fortification in the ration as compared to pigs raised on quality legume pasture. Examples of grower and finisher rations are listed in Tables 4, 5, and 6. Under full feeding or *ad libitum* feeding, the 16-14-12 percent crude protein rations are recommended. If good-quality legume pasture is available, then a 14-12-10 percent crude protein ration may be utilized. If restricted feeding is practiced after 100 pounds, the protein content of the feed should be 16 to 14 percent to insure adequate protein intake. Rations 6 and 7 in Tables 4, 5, and 6 are examples of "no-grain" high-molasses diets that can be used where maximum growth rate is not required.

GARBAGE AS A FEED FOR GROWING-FINISHING SWINE

The importance of garbage as feed for swine in Hawaii is well established. Primary sources of garbage in the state are military installations, hotels and restaurants, institutions, and residences. Before use, all garbage must be cooked. As expressed in Section 33, Public Health Regulations, Department of Health, State of Hawaii, "All garbage, offal and swill, regardless of previous processing, shall, before being fed to any swine, be thoroughly boiled at least thirty (30) minutes, and then cooled slowly so that every part thereof shall have been at the boiling point of water for at least thirty (30) minutes, unless treated in some other manner which shall have been approved in writing by the Board as being as effective as such boiling and cooling, to protect the public health."

Garbage varies greatly in chemical composition and nutritive value because it comes from different sources and it is composed of a variety of materials. Military and institutional garbage generally are more highly digestible and superior as compared to municipal or residential garbage. Work conducted in Hawaii, New Jersey, Virginia, and California indicate that the composition of garbage from different sources is approximately as shown in Table 7.

One of the characteristics of cooked garbage is its high moisture or low dry-matter content and low fiber content. Although digestibility and nutrient content on a dry-weight basis of some types of garbage may approach adequacy, pigs fed wet garbage are not able to consume sufficient amounts to meet their nutritive requirements due to the very high moisture content. For young pigs under 75 pounds even good-quality garbage will be too low in protein to meet their requirements. For older pigs, however, cooked garbage of good quality can satisfy protein needs. Garbage containing a variety of plant and animal protein would be ex-

Table 1. Nutrient requirements of growing and finishing swine (expressed in percentage or amount per pound of total ration)[1]

	Full-fed on cereal grains			Full-fed on corn		Full-fed on wheat, barley, oats	
Liveweight, lb.	11–22	22–44	44–77	77–132	132–220	77–132	132–220
Expected daily gain, lb.	0.66	1.10	1.32	1.65	1.98	1.54	1.76
Protein and energy:							
Crude protein, %	22	18	16	14	13	15	14
Total digestible nutrients, %	80	80	75	75	75	70	70
Digestible energy, Kcal.	1587	1587	1496	1496	1496	1406	1406
Inorganic nutrients:							
Calcium, %	0.80	0.65	0.65	0.50	0.50	0.50	0.50
Phosphorus, %	0.60	0.50	0.50	0.40	0.40	0.40	0.40
Salt (NaCl), %	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Vitamins:							
B-Carotene, mg.	2.0	1.6	1.2	1.2	1.2	1.2	1.2
Vitamin A, I.U.	1000.0	800.0	600.0	600.0	600.0	600.0	600.0
Vitamin D, I.U.	100.0	90.0	90.0	60.0	60.0	60.0	60.0
Thiamine, mg.	.6	.5	.5	.5	.5	.5	.5
Riboflavin, mg.	1.4	1.4	1.2	1.0	1.0	1.0	1.0
Niacin[2], mg.	10.0	8.2	6.3	4.5	4.5	4.5	4.5
Pantothenic acid, mg.	6.0	5.0	5.0	5.0	5.0	5.0	5.0
Vitamin B_6, mg.	.7	.7	.5	—	—	—	—
Choline, mg.	500.0	408.0	—	—	—	—	—
Vitamin B_{12}, mcg.	10.0	7.0	5.0	5.0	5.0	5.0	5.0

1 Adapted from National Academy of Sciences Publication 1599 (1968), *Nutrient Requirements of Swine.*

2 It is assumed that all the niacin in the cereal grains and their by-products is in bound form and is thus largely unavailable.

Table 2. Essential amino acid requirements of swine (expressed as percentage of the diet)

Amino acid	Growing pigs weighing 11–22 lbs.	Growing pigs weighing 44–77 lbs.	Finishing pigs
Arginine[1]	—	0.20	—
Histidine	0.27	0.18	—
Isoleucine	0.76	0.50	0.35
Leucine	0.90	0.60	—
Methionine[2]	0.80	0.50	—
Phenylalanine[3]	—	0.50	—
Threonine	0.70	0.45	—
Tryptophan	0.18	0.13	0.09[1]
Valine	0.65	0.50	—
Lysine	1.20	0.70	0.50

1 This level is adequate; the minimum requirement has not been established.
3 Cystine can satisfy 40 percent of the need for methionine.
2 Tyrosine can satisfy 30 percent of the need for phenylalanine.

Table 3. Trace minerals for swine

Mineral element	Requirement (mg./lb. diet)	Toxic level (mg./lb. diet)
Copper	2.7[1]	113[2]
Iron	36.3[1]	2270
Iodine	0.1	—
Magnesium	181[1]	—
Manganese	9.1	1814
Zinc	23[3]	907
Selenium	0.5	2.3

1 Baby-pig requirement.
2 Toxic symptoms have been obtained on a few occasions.
3 Higher levels may be needed if excess calcium is fed.

Adapted from National Academy of Sciences Publication 1599 (1968), *Nutrient Requirements of Swine.*

Table 4. Sample rations for growing-finishing pigs in drylot, 16 percent grower (50 to 100 pounds liveweight)

Ingredients	1	2	3	4	5	6	7
Corn-milo-barley	764.0	790.0	801.5	610.5	516.5		
S.O.M. (44%)	210.0	140.0		168.0	162.0	365.0	300.0
C.S.M. (44%)			90.0				
Tuna meal (55%)		50.0	50.0	35.0	35.0		50.0
Meat and bone meal (45%)			50.0	25.0	25.0		
Wheat middlings-millrun-bran (13.5%)					100.0		
Molasses				150.0	150.0	463.0	484.0
Bagasse pith						100.0	100.0
Vegetable oil-fat						50.0	50.0
T.M. salt	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Ground limestone	7.5	6.5		3.0	3.0		
Steamed bone meal, dicalphos or tricophos	10.0	5.0				10.0	4.0
Vitamin premix[1]	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Antibiotic	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Zinc sulfate	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.
Sodium tripolyphosphate						3.5	4.0
Crude protein	16.1	16.0	16.1	15.9	16.1	16.1	15.9
Total digestible nutrients (T.D.N.)	77	77	76	74	73	63	62
Calcium	.60	.69	.95	.77	.77	.69	.75
Phosphorus	.58	.65	.91	.63	.68	.56	.56
Crude fiber	3.0	2.7	3.0	2.3	2.8	5.9	5.6

[1] Vitamin mix should contain a minimum of 300,000 I.U. Vitamin A, 50,000 I.U. Vitamin D, 500 mg. riboflavin, 2,500 mg. niacin, 1,200 mg. pantothenic acid, and 2 mg. B_{12} in each pound.

Table 5. Sample rations for growing-finishing pigs in drylot, 14 percent grower-finisher (100 to 150 pounds liveweight)

Ingredients	1	2	3	4	5	6	7
Corn-milo-barley	820.5	844.0	851.0	609.0	509.0		
S.O.M. (44%)	154.0	86.0		121.0	121.0	318.0	253.0
C.S.M. (44%)			68.0				
Tuna meal (55%)		50.0	34.0	35.0	35.0		50.0
Meat and bone meal (45%)			34.0	25.0	25.0		
Wheat-middlings-millrun-bran (13.5%)					100.0		
Molasses				200.0	200.0	510.0	530.0
Bagasse pith						100.0	100.0
Vegetable oil-fat						50.0	50.0
T.M. salt	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Ground limestone	7.5	7.0		2.0	2.0		
Steamed bone meal, dicalphos or tricophos	10.0	5.0	5.0			10.0	4.0
Vitamin premix[1]	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Antibiotic	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Zinc sulfate	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.
Sodium tripolyphosphate						4.0	4.0
Crude protein	14.1	14.1	14.0	13.8	14.2	14.0	13.9
Total digestible nutrients (T.D.N.)	77	77	76	73	72	62	61
Calcium	.60	.69	.80	..76	.76	.71	.77
Phosphorus	.51	.53	.73	.53	.59	.53	.53
Crude fiber	2.8	2.5	2.8	2.2	2.7	5.6	5.3

[1] Vitamin mix should contain a minimum of 300,000 I.U. Vitamin A, 500,00 I.U. Vitamin D, 500 mg. riboflavin, 2,500 mg. niacin, 1,200 mg. pantothenic acid, and 2 mg. B_{12} in each pound.

Table 6. Sample rations for growing-finishing pigs in drylot, 12 percent finisher (150 pounds market weight)

Ingredients	1	2	3	4	5	6	7
Corn-milo-barley	875	898	902	531	441		
S.O.M. (44%)	99	32		100	90	275	213
C.S.M. (44%)			41				
Tuna meal (55%)		50	21	35	35		50
Meat and bone meal (45%)			20	25	25		
Wheat middlings-millrun-bran (13.5%)					100		
Molasses				300	300	553	570
Bagasse pith						100	100
Vegetable oil-fat						50	50
T.M. salt	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Ground limestone	7.5	6.5	3.0	1.0	1.0		
Steamed bone meal, dicalphos or tricophos	10.0	5.0	5.0			10.0	4.0
Vitamin premix[1]	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Antibiotic	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Zinc sulphate	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.	25 gms.
Sodium tripolyphosphate						4.0	4.0
Crude protein	12.1	12.2	12.0	12.2	12.2	12.1	12.1
Total digestible nutrients (T.D.N.)	78	77	77	70	70	61	60
Calcium	.57	.61	.63	.76	.76	.73	.78
Phosphorus	.49	.51	.58	.50	.56	.41	.41
Crude fiber	2.6	2.3	2.6	1.9	2.4	5.4	5.1

[1] Vitamin mix should contain a minimum of 300,000 I.U. Vitamin A, 50,000 I.U. Vitamin D, 500 mg. riboflavin, 2,500 mg. niacin, 1,200 mg. pantothenic acid, and 2 mg. B_{12} in each pound.

pected to be fairly well balanced in amino acid composition. In most instances, the ash value and calcium and phosphorus content of good-quality cooked garbage are such that the mineral requirements for older growing-finishing pigs are satisfied. Considerable variation exists in the data on economy of feeding garbage. A range from 30 to 130 pounds of gain per ton of garbage has been reported. Tables 8 and 9 indicate the approximate amount of wet garbage that growing-finishing pigs must consume to meet their protein and energy requirements. Normal consumption of wet garbage (75- to 80-percent moisture) will vary from about 8 to 10 pounds daily for 50-pound pigs up to around 30 to 40 pounds daily for 200-pound pigs. Because of the variable nature of garbage, faster, more economical gains can be obtained by adding supplements. If high-fat garbage is being fed, the addition of protein supplements should result in leaner carcasses. Depending on the size of the pig, a 36- to 40-percent protein supplement may be fed at the rate of ½ to 1 pound daily, either as a top dressing or mixed in the garbage just before feeding. Protein rather than complete feed mixes should be used as supplements. Examples of protein supplements are given in Table 10. The use of antibiotic-fortified supplements may be advisable depending on the general disease level on the farm. Garbage is best used for finishing pigs (after pigs are 100 pounds) rather than for the young pig. Field observations on garbage feeding have shown the following:

1. The amount of water added to garbage should be kept to the minimum needed for cooking so that the garbage is consumed in sufficient amounts to nearly meet the pig's nutrient requirements. Pigs should be fed all the garbage they can eat. A lack of feed results in a lack of gain and in increased maintenance cost.

2. Faster, more economical and higher gains are usually obtained when garbage is supplemented with protein. Feeding supplements with the garbage results in pigs reaching market weight faster and requiring less garbage per unit of gain.

3. A supplement should contain a minimum of 35 to 40 percent high-quality protein and be fortified with minerals and vitamins. Antibiotics should be included if the disease level on the farm warrants it. The amount of supplement required per head will vary according to the type of garbage fed and the size of pig. Growing pigs should probably receive ½ to 1 pound of supplement daily.

METHODS OF FEEDING: GRAIN MIXTURES

An understanding of the effects of the various feeding systems and methods of feeding will help the producer select the one best suited to his particular needs.

Self or Full Feeding Versus Restricted or Limited Feeding

Up to 100 to 125 pounds live weight, pigs should be on an *ad libitum* feeding program so as to permit the maximum growth and development of muscle. After this weight, the intake of feed may be restricted if the type of pig and the energy level of feed warrant this practice and if the price differential on hogs will justify it. A common practice is to restrict the daily feed intake to about 5 pounds, which is about the daily feed intake of a 100-pound pig. This level represents about a 70-percent restriction from 100 to 200 pounds weight. Table 11 summarizes the characteristics of limited feeding based on results from research trials comparing limited-fed pigs to full-fed pigs.

The economic advantage through improved feed efficiency has generally failed

Table 7. Chemical composition of garbage (wet basis)

Type	Moisture	Crude protein	Fat	Crude fiber	Ash
	%	%	%	%	%
Hotel and restaurant	75–85	2.5–3	3–4	0.5	1.0
Institutional (hospital)	75–85	2.5–3	3–4	0.5	1.0
Military	70–80	3–4	7–9	0.5	1.5
Municipal-residential	80–85	2.5–3	3–4	1–1.5	1.5
Commercial growing-finishing grain mix ration	10	14–16	4	3	4.0

Table 8. Pounds of wet garbage pigs must consume daily to meet their protein requirement

Types of garbage	Weight of pig			
	50	100	150	200
Hotel and restaurant (84%)[1]	20	29	34	40
Institutional (83%)	19	28	33	38
Military (74%)	12	17	20	24
Municipal (83%)	17	24	28	33

[1] Percent moisture in parenthesis.

Table 9. Pounds of wet garbage pigs must consume daily to meet their energy requirement

Types of garbage	Weight of pig			
	50	100	150	200
Hotel and restaurant	15	25	32	38
Institutional	15	25	32	38
Military	9	14	18	22
Municipal	18	29	37	44

Table 10. Crude protein supplements, 35 to 43 percent, for growing-finishing hogs to be fed in addition to garbage or with grains

	1	2	3	4	5
S.O.M. (41–44%)	870	665	650	550	400
C.S.M.-peanut meal (41–44%)					100
Meat and bone meal (45%)			135	200	150
Tuna meal (55%)		250	130		100
Dehydrated alfalfa meal (17%)				100	150
Wheat-middlings-millrun				75	
Limestone	25	35	35	15	20
Steamed bone meal-dicalphos	60			20	40
T.M. salt	25	25	25	20	20
Vitamin premix	20	25	25	20	20
% crude protein	36–38	41–43	40–42	34–36	35–37
% calcium	2.9	2.6	3.5	3.5	4.4
% phosphorus	1.4	1.2	1.5	1.7	2.0

to materialize when limited-fed pigs were compared to self-fed pigs. Limited feeding may cause some problems. In group feeding, certain animals may get more than their desired quota of feed and will be ready for market earlier with less uniformity in the group. Where limited feeding is practiced, the amount of available feed space required is critical as compared to *ad libitum* feeding. This greater space is required so that the less aggressive pigs will have equal access to the feed. Limited feeding generally improves carcass quality, but the advantage has not always been great. Some management benefits may be obtained from controlled feeding practices. Where the pens are laid out in a long, narrow arrangement with the feed dropped on the floor at the upper end of the pen, the need for cleaning will be practically eliminated. Feed wastage will be minimized by forcing the pigs to clean up the feed on the floor before the next feeding. The slower growth of limited-fed pigs will reduce the turnover of hogs in a unit. This may be a disadvantage where building space is at a premium and fast turnover of animals is required. More labor is required per unit of pork because of the time required to hand feed and the longer feeding period.

A possible compromise to avoid the disadvantages of restricted feeding would be to feed slightly less (5 percent) than full feed so that feed wastage would be reduced without severely reducing growth.

Complete Mixed Rations Versus Feeding Grain and Supplement Separately

With the increasing interest in growing field corn in the state, some producers may have access to ear or shelled corn. Without access to grinding and mixing facilities, it will be necessary to feed whole corn and supplements separately.

Generally, pigs fed a complete mixed ration gain at a faster rate than pigs fed

Table 11. Effect of restricted feeding in preformance of growing-finishing pigs

Trait	Effect	Comments
Growth rate	Reduced	Often in group-fed pigs, growth rate is reduced to a much greater extent than desirable. It normally takes 10 to 14 days longer for pigs that have been on restricted diet to reach 200 pounds market weight.
Daily feed intake	Reduced	Feed wastage is reduced.
Feed requirement	Increased	Under practical conditions, the majority of data indicate a higher feed requirement for group-fed pigs. Based upon 43 experiment station comparisons feed requirement was increased 4 percent.
Carcass quality	Improved	Experiment station results have indicated generally a reduction in backfat (8 percent), an increase in lean cuts (3 percent), and an increase in loin eye area (5 percent). Softer carcasses are a result where severe feed restriction is practiced.
Dressing percentage	Increased	

corn and supplement separately, free choice. Several experiment station tests in the Midwest have indicated about a 5-percent increase in growth. The palatability of the supplement as well as the grain will influence consumption, performance, and subsequent cost. If the supplement fed is very palatable, then overconsumption may result, thus needlessly increasing cost. Economy of gain is often in favor of free-choice feeding of grain and supplement separately, due to elimination of mixing costs. Generally, it is desirable to grind and mix rations containing barley or oats because of the higher fiber content. Based on many trials, the following may be concluded:

1. On pasture, pigs of all weights gain more rapidly when fed complete rations than when fed separate rations of a free-choice grain and a supplement.

2. If, however, the value of good swine pasture is to be realized, it is probably best to feed a free-choice grain-supplement separate ration. Gains may be reduced, but the pasture then has an opportunity to express itself in replacing some of the protein, minerals, and vitamins in the ration.

3. In drylot rearing, free-choice grain-supplement separate feeding may provide equal gains and feed efficiency, but on the whole there appears to be greater efficiency from the ground complete mixed ration.

4. Complete mixed rations give a better control of supplement consumption which may be a problem when supplement is palatable or if the grain is hard or unpalatable.

5. Pigs tend to be more uniform with fewer runts, or pigs that do not perform up to par, on complete mixed rations.

Commercial 36- to 40-percent crude protein supplements are available. Examples of supplements that can be added to grain for growing-finishing hogs are indicated in Table 10.

Pelleted Rations Versus Meal

Many of the commercial rations available to the swine producer come in both pelleted and meal form. Usually pellets cost $2.00 to $4.00 more per ton. The question arises then, does it pay to feed pelleted rations for growing-finishing pigs? Based on many experimental trials comparing pelleted and meal rations, the following conclusions can be drawn:

1. With rations that contain larger amounts of fibrous ingredients and/or unpalatable ingredients, pelleting has generally resulted in more rapid and efficient gains. Pelleting barley rations and certain corn-oat combination rations has usually improved pig growth and reduced cost of gains. However, pelleting of rations based primarily on ground corn, milo, and wheat has not consistently increased rate of gain or decreased feed requirements per unit of gain. Results of 16 experiment station trials indicate about a 4-percent increase in gains and a 2-percent increase in feed efficiency when pelleted corn rations were compared with meal rations. When barley and corn-oats pelleted rations were compared with meal, up to 14- to 15-percent increase in gains and 10- to 15-percent increase in feed efficiency were obtained.

2. Pelleted rations tend to be less dusty and also prevent selective eating of ingredients. Thus less feed is wasted and efficiency of feed usage is improved. Feed intake often is improved due to increased palatability and lack of dustiness.

3. Depending upon the amount of increased performance, the additional cost of pelleting may offset any performance advantage.

4. Some work has indicated that pelleted feed increases the incidence of stomach lesions and ulcers.

Liquid Feeding

The trend toward larger and more automated swine operations has led to interest in liquid feeding. Basically, liquid feeding consists of mixing dry feed with water in certain ratios or proportions to make a gruel. A great variety of feed and water ratios has been used ranging from paste feeding to water-to-feed ratios of 6:1. Most of the work on liquid feeding has been with growing-finishing pigs. Field observations and limited research work to date indicate the following conclusions:

1. The system will eliminate the feed dust problem, but the operation tends to be more complex.

2. Feed intake appears to be stimulated under conditions of heat and humidity. Increased feed intake might be expected in early weaned pigs or convalescent pigs fed wetted diets as compared with dry diets.

3. Improvement in rate of gain or feed efficiency has not consistently been shown for liquid feeding. Marked differences in performance are not evident between pigs fed liquid and dry diets, free choice. However, when pigs are on limited feed, performance on liquid or wetted diets appears to be slightly improved over pigs fed dry diets. Performance has been adversely affected on liquid feeding programs (water-to-feed ratios of 1½:1 to 3:1) in which growing-finishing pigs have not had free access to water. There is no evidence that liquid feeding of pigs will improve protein and dry matter digestibility.

4. Feed in liquid form apparently has no effect on dressing percentage, average backfat thickness, or percentage of lean cuts when compared with an equivalent feed intake in dry form.

5. With brood sows, apparently, feed intake can be limited by increasing the water-to-feed ratio to 5:1 or 6:1 and maintaining the sow in a more contented condition.

More research data and results of commercial application are needed before definite recommendations can be made concerning liquid feeding for any class of pig.

Frequency of Feeding

With the increased interest the last few years on restricted feeding, there are currently on the market many automatic feeding systems that allow for feeding pigs at various intervals. Increased labor costs result if restricted feeding is done by hand, but increased investment results if it is done by equipment. The question then is one of economic feasibility. Results of work conducted at several experiment stations indicate that there is generally no advantage in performance or carcass quality when a given level of daily feed is given in more than two feedings daily. Feeding frequencies from once a day up to twelve times a day have been compared. There would be a practical limitation in feeding only once daily under a restricted feeding regime from the standpoint of competition for feed by the pigs.

USE OF FEED ADDITIVES: ANTIBIOTICS

Feed additives are defined as drugs that are added to swine rations in small amounts. The purpose of these additives is to improve the performance of the animal. Feed additives should not be considered nutrients. The need and effectiveness of feed additives vary with such conditions as level or build-up of disease in the herd, general sanitation and management of the herd, age of the animal, level of additive fed, previous antibiotic fed, change in environment, stress conditions, and specificity of the antibiotic or drug in relation to the disease organisms present.

A swine herd with a low level of disease will generally derive less benefit from the use of feed additives compared with a herd with a high disease incidence. Some research has indicated that there may be benefit in using higher levels of feed additives for short periods of time and a reduced level or none for subsequent periods.

Young pigs have generally benefited in growth from the use of feed additives in the ration. This has not always been the case with finishing pigs. Some experimental results have suggested the advisability of rotating feed additives rather than using the same one continually. Rotation of feed additives can be accomplished either by using a certain feed additive for all classes of swine and switching to another additive periodically or by using a different feed additive for each class of swine—one additive for starter rations, a second additive for grower rations, and a third additive for finishing rations. It is felt that rotating feed additives will result in lessening the organism's resistance to the additives.

High levels of feed additives and combinations of additives have come into prominence in starter and grower rations for pigs. These are recommended when a specific problem shows up and for pigs that perform poorly. Lower levels of additives or none at all are generally recommended as long as pigs remain healthy and are gaining well.

Certain additives in swine feeds will result in traces of the drugs or their breakdown products being present in the meat. These are normally eliminated by the animal's natural body function if the additive is removed from the feed for an adequate period before slaughter. Specific withdrawal times have been established by the Food and Drug Administration. It is important to read the feed tag and observe the instructions and recommendations. Swine producers who use additives in rations mixed on the farm should always handle them with care and caution. Some individuals may be sensitive or become sensitized through breathing dust or having continual contact with certain drugs. When handling feed additives, the following precautions are recommended:

1. Read additive labels for your information and protection, and follow them exactly and accurately.

2. Avoid breathing dust and avoid contact with skin, eyes, and mouth.

3. Wash thoroughly after handling additives.

4. Wash clothing worn while handling drugs as soon as possible or store the clothing away from children and pets.

5. Destroy empty additive containers; do not reuse them.

6. Keep additives out of reach of children and pets.

Feed additives should always be considered an aid to swine production and not a substitute to cover up sloppy management practices. High levels of feed addi-

Table 12. Recommended antibiotic levels for swine

	Pig weight lb.	Antibiotic level gm.
		Per ton of complete feed
Baby pigs	10	40
	25	40
Growing pigs	50	10–20
Finishing pigs	100–200	10
Therapeutic level		100–200[1]
		Per ton of supplement
Supplement to be fed free choice with grain		50–100

[1] If pigs are in very poor condition and will not eat, antibiotic can be given in drinking water.

tives should not be used routinely if herd health can be maintained without them. If high levels of feed additives must be used, then management and sanitation practices should be checked. Recommended antibiotic levels for growing-finishing pigs are given in Table 12.

EFFECT OF FEED AND FEEDING PRACTICES ON CARCASS QUALITY

Nutrition plays an important role in determining the quality of pork produced. Feeding practices as well as the feed ingredients used in the ration will affect carcass quality.

It is recognized that the level, the quality, and the source of protein in the ration have an effect on carcass merit. If protein levels are low, performance and percentage of lean cuts tend to decrease, while amount of fat tends to increase. Increasing the protein content of the ration will usually result in less fat deposition in the carcass. However, higher-than-normal levels of protein in the diet does not necessarily result in any further improvement of carcass composition or quality. For best carcass results, the ration must have the proper protein-energy ratio. As energy intake increases, the protein requirement increases. Consequently, as energy is increased beyond a certain level, the protein intake needs to be increased.

Poor protein quality will affect the carcass in a way similar to low protein quantity. Quality of protein is determined by the number and levels of essential amino acids present in the feed ingredient. It has been shown that the addition of certain amino acids such as lysine to the ration may improve the carcass quality. Some research work has shown that the source of protein may influence the fat-to-lean ratio in the carcass.

The energy content of growing-finishing rations will affect carcass merit. During the growing period, a high level of feeding should be practiced to permit

maximum development of muscle. During the finishing period, restricting feed or energy intake will tend to increase lean in the carcass. Increasing energy levels in the ration will tend to increase backfat, particularly in rations low in protein. Restricted feeding does tend to produce slightly softer carcasses. The addition of fiber to the ration will tend to reduce the energy intake and increase the percentage of lean cuts. However, high fiber levels in the ration will tend to reduce digestibility of the feed and dressing percentage. Although restricted feeding may have some benefit on carcass quality, it may not always be economically feasible because it will reduce the performance of the live animal.

It is recognized that some feed ingredients will produce soft fat in pork carcasses, whereas others will produce firm carcasses. Feed ingredients such as rice bran, rice polishings, hominy feed, peanuts, soybeans, soybean oil, other plant oils, or garbage produce soft fat in carcasses. Rations that include barley or wheat as the grain source, beef tallow, and cottonseed meal will produce firm pork carcasses.

GENERAL MANAGEMENT OF PIGS FROM WEANING TO MARKET

Feeder and Watering Requirements

1. Feed and watering management information is shown in the following table:

Pig weight	Daily gain	Average daily feed consumed ad libitum	Average daily water consumed	Manure prod. daily—liquids and solids
lbs.	lbs.	lbs.	lbs.	lbs.
50	1.4	2.7	1.5	0.5
100	1.6	5.0	1.75	1.1
150	1.8	6.5	2.25	1.6
200	2.0	7.5	2.50	2.1

2. Number of pigs per linear feet of self-feeder space or per self-feeder hole should be as follows:

	Dry lot	Pasture
Weaning to 75 lbs.	4	4–5
75 lbs. to market	3	3–4

3. The percentage of self-feeder space allotted to protein supplement should be as follows:

	Dry lot	Pasture
Weaning to 75 lbs.	25%	20–25%
75 lbs. to 125 lbs.	20%	15–20%
125 lbs. to market	15%	10–15%

4. For hand feeding or watering in troughs, allow the following amount of space per pig:

Weaning to 75 lbs.	0.75 ft.
75 to 125 lbs.	1.00 ft.
125 lbs. to market	1.25 ft.

5. Self feeding: Allow 1 self feeder hole or 1 linear foot of feeding space per 4 hogs from weaning to market.

Floor Space - Shelter Area	Weaning to 75 lbs.	75 lbs. to 125 lbs.	125 lbs. to market weight
	Sq. ft. per pig	Sq. ft. per pig	Sq. ft. per pig
Confinement rearing (total space, solid floor)	4–5	6–8	10–12
Confinement rearing (total space, slotted floor)	3–4	5–6	8–9
Shade area (pasture rearing)	4–5	6–8	8–10

6. When salt or mineral is fed free choice, allow 3 self-feeder holes or 3 linear feet per 100 pigs.

7. Automatic watering cup should be provided per 20 to 25 pigs (Figures 1 and 2). An automatic waterer with 2 openings should be considered as 2 cups. Place waterers some distance from feeders (10 feet) to prevent waterers from clogging. Place waterers at low end of pen to aid in dunging control.

8. Minimum capacity of water for 10 pigs per day should be 25 gallons in summer and 15 gallons in winter. Growing pigs need ½ to 1½ gallons water daily.

9. When self feeders are used: Adjust and regulate baffle feed plate; don't locate feeder too close to waterer; and don't have trough openings that are too large. Regulation of the feed flow is a necessary precaution to prevent feed wastage.

Floor Space–Shelter Area

During hot weather, pigs require slightly more area than during cool weather. The type of material of the shade or pen roof as well as its color affects reduction of heat stress. Aluminum and galvanized steel roofing painted white on top and black on bottom are a most effective shade material. Vegetation adjacent to shade will reduce the animal's heat load.

Grouping Pigs

1. Pigs of different sizes should not be penned together. Range in weight should not exceed 20 percent above or below the average or 15 pounds, whichever is smaller.

2. Pigs should not be constantly resorted and mixed. Research has shown that mixing pigs from different pens has a greater and more consistently depressing effect on performance than moving pigs from one pen to another without remixing.

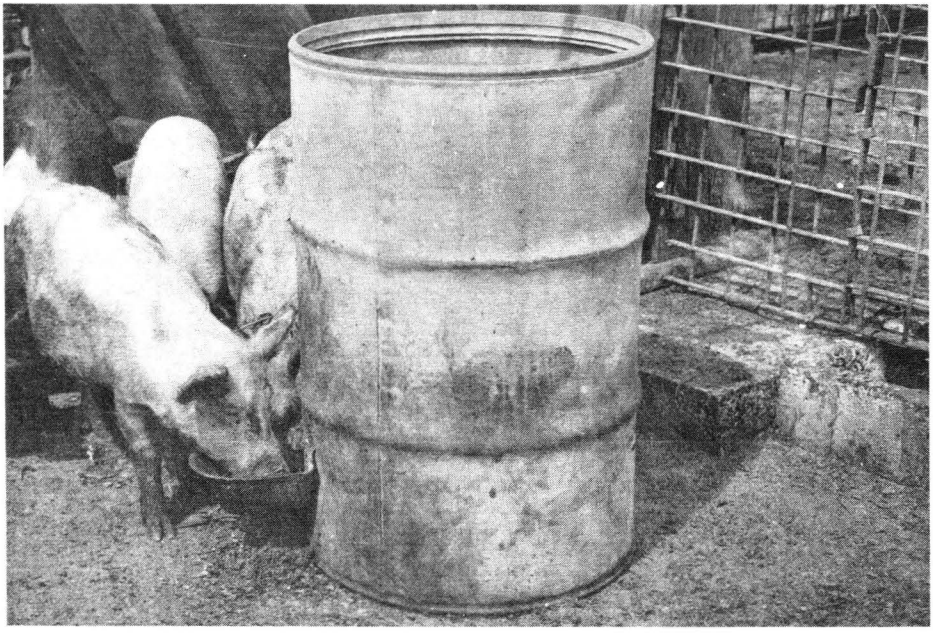
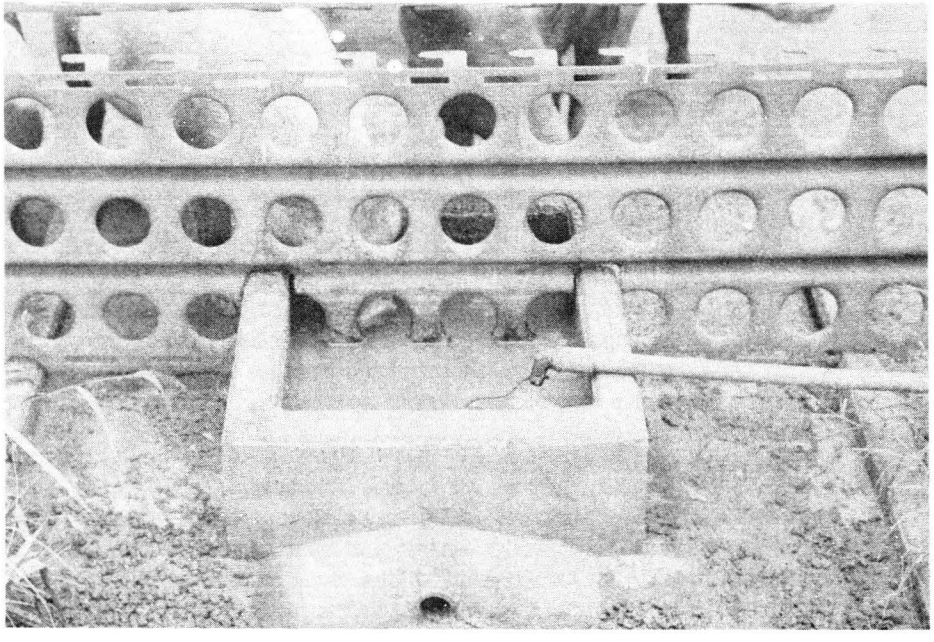


Figure 1. Automatic waterer fitted to old oil drum.

Figure 2. Home-made concrete trough fitted with valve and float. Hole in front can be opened for cleaning.



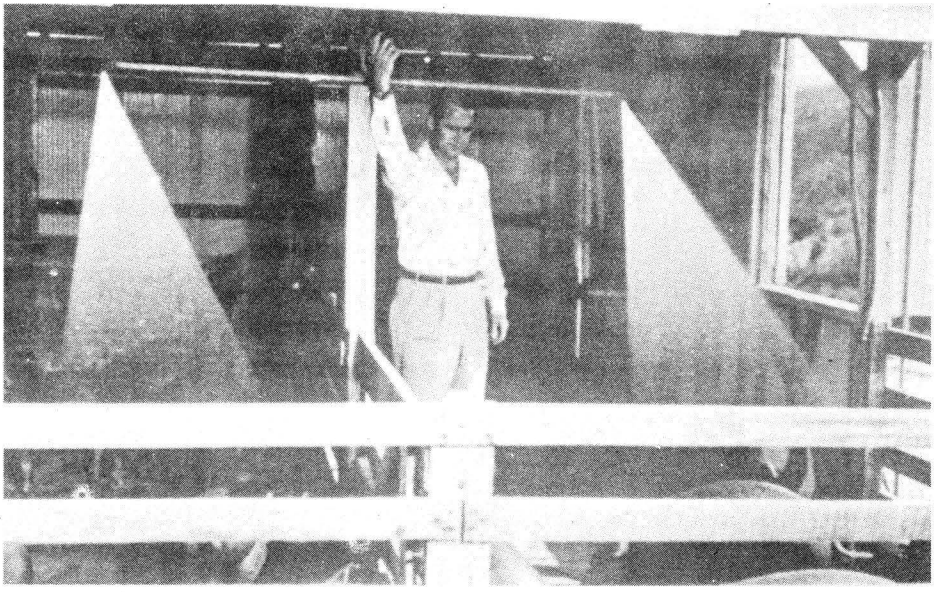


Figure 3. Spray cooling.

3. Number of pigs to run together: The younger the pigs, the smaller the grouping should be. The maximum number of pigs to run together in confinement rearing is as follows:

	Weeks			
	3	4	5	6
Number of pigs per group	10	20	25	50

Optimum Temperature for Growing Finishing Pigs

Environmental temperatures can influence the cost of raising pigs and subsequent market profit. Because the hog is a non-sweating animal, it is quite susceptible to heat. As the temperature rises above a certain point, daily feed consumption decreases, daily gain decreases, and the amount of feed required to produce a pound of pork increases substantially. The pig's reaction to temperature varies with its weight and with relative humidity. The heavier the hog becomes, the more it is affected by high temperature. Thus, more emphasis should be given to keeping the older, heavier hogs cool than the younger, lighter pigs. Optimum temperature for maximum performance in growing-finishing pigs is around 60 to 75^{o}F. High humidity appears to affect pig growth more when temperatures are high than when they are low. When temperatures exceed 80^{o}F., artificial cooling should be considered.

Spray cooling: Allow 1 nozzle for each 25 hogs; 1 gallon per nozzle per hour at 20 to 40 pounds of pressure. Locate nozzles near the manure area to keep the rest of the pen as dry as possible. Locate nozzles 4 to 5 feet above the floor (Figure 3).

Sanitary hog wallows: 100 square feet of wallow will accommodate 50 pigs if shade or shelter is nearby (Figure 4).

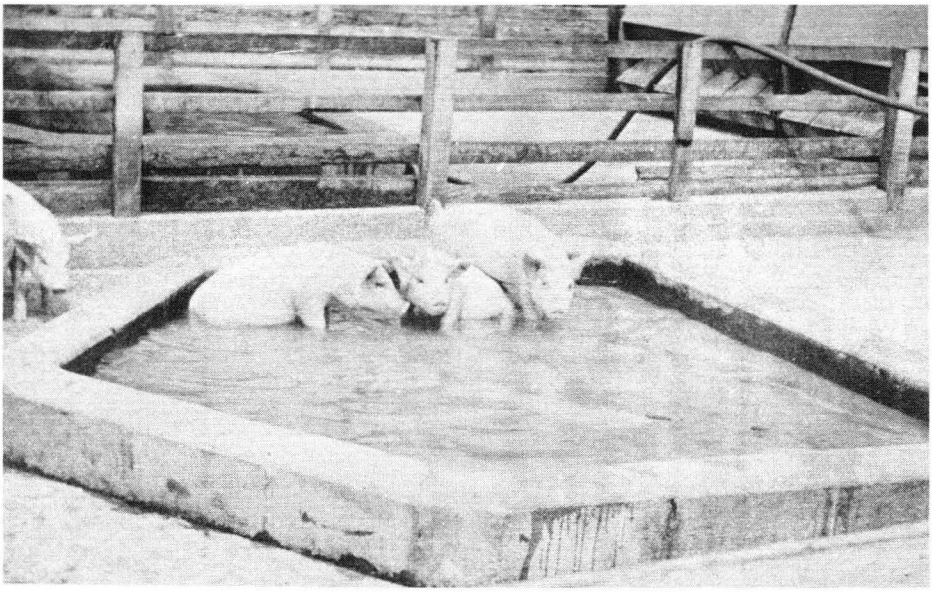


Figure 4. Concrete hog wallow.

Use of Pasture

In Hawaii pasture is generally not available for hog rearing. However, if land is available, pastures may be useful. Good legume or legume-grass pasture will accommodate 20 growing-finishing pigs per acre on a full-feeding program or 10 to 12 pigs per acre on a limited-feeding program. The use of good-quality legume or legume-grass mix can result in a total feed saving of 3½ to 7 percent per 100-pound gain.

Pastures should be clipped periodically if not being grazed uniformly. Portable shades and shelters can be used and periodically moved so as to prevent development of dust and mud wallows. Pasture lots should be rotated to prevent parasitisms.

Pasture mixes suitable for Hawaii conditions are given in Table 13.

Purchasing and Handling Feeder Pigs

When purchasing feeder pigs to be grown out to market, the buyer must use specific feeding and management practices at time of delivery if maximum results are to be obtained. In Hawaii, most feeder pigs are secured at about 80-pound weight and are finished out on garbage. These pigs are either locally produced, shipped from one island to another, or imported from the mainland U. S. Stress factors are numerous as feeder pigs are moved from one farm to the other and from one area to the other. It is this stress situation that results in potential problems in feeders. General guides for purchasing and handling feeder pigs are:

1. Buy healthy pigs that have grown well. Know the farm conditions under which the pigs have been reared. Watch

Table 13. Suggested legume pasture mixtures to use for swine in Hawaii[1]

		Seeding rate when used in established grass pasture	Seeding rate when used with other established grass pasture	Seeding rate when used singly
		Pounds per acre	Pounds per acre	Pounds per acre
Sea level to 1,000 ft.	Bur clover[2]	1–2	1	10–15
	Black medic[2]	1–2	1	10–15
	Alfalfa	5–10	5	25
	Lotononis	½–1	½	2
	Stylo	1–2	1	2
	Sitratro	1–2	1	4
	Glycine; Clarence Cooper, or Tinaroo strains	2–4	2	4
	Kaimi clover	5	1–2	5–7
Over 1,000-ft. elevation	Mother white clover, New Zealand certified	1–2	1	2
	Ladino white clover	1–2	1	2
	Big trefoil[3]	2	1	2
	Lotononis	½–1	½	2
	Vetch, common or hairy varieties	10–15	5	15
	Kenland red clover	5–10	5	10–15
	Alfalfa	10–15	15	25

1 Recommendations by Clarence Lyman, Extension Specialist in Pasture Management, University of Hawaii. NOTE: All legume seeds should be inoculated with the proper bacteria to ensure good nodule formation.

2 Best growth in fall, winter, spring.

3 Best growth in summer.

out for scours, rough haircoat, and other signs of trouble.

2. During transporting try to reduce stress conditions. Pigs should not be overheated while loading or unloading. Pigs should be handled carefully and not overcrowded, particularly during hot weather. Space for trucking should be:

Size of pig	*Area per pig*
40 to 50 lb.	1 to 1¼ sq. ft
50 to 80 lb.	1¼ to 1½ sq. ft.

It is desirable to separate mixed groups of pigs by size. Loading chutes and truck or pen panels should be free of nails and sharp objects. Truck beds with metal floors can become slippery when wet and precaution should be taken to prevent excessive slipping. During truck hauling, sudden stops and sharp turns should be avoided. On inter-island shipment, it is important to provide water and shade; otherwise heat prostration can occur.

3. Newly purchased pigs should be isolated and placed in separate draft-free, dry pens. Pens for the new pigs should be cleaned and disinfected before the pigs arrive. Remember that the new pigs are not necessarily immune to the disease organisms that may be present on the new premises, nor are the pigs on the farm necessarily immune to the organisms of the purchased pigs. Isolating new pigs help to prevent the spread of disease from pigs already on the premises to the new pigs or vice versa. New pigs should not be mixed with the pigs already on the farm.

4. Pigs should be conditioned before they are switched completely to the new feeding program or placed on full feed. Ten to 14 days should be allowed for this transition. The buyer should know what kind of feeding and management program the previous raiser has been practicing so that a similar program can be carried on during the changeover period. Most feeder pigs up to the time of purchase have been raised on grain. The change from grain feeding to garbage is a drastic one and the pigs cannot be expected to adapt to this overnight. To reduce stress, the use of high levels of antibiotics in the rations is advisable. Some commercial feed companies have special conditioner rations that can be used for this stress period. Often it is advisable to place the pigs on medicated water for 4 to 5 days. If the pig is running a temperature, it will probably not eat much of the ration so that medication in the feed will be of limited value. Although feed should be somewhat restricted and increased gradually during this period, water should always be available to the pig.

5. Pigs should be inspected for external parasites and treated accordingly. Table 14 gives the recommended insecticides.

6. After the pigs have gotten over the effects of shipping, it is desirable to worm them. One of the recommended wormers such as Piperazine or Atgard V may be used.

7. Watch out for scours and other problems. There are different types of scours, so treatment must be selected to control the organism that is causing the trouble. At the first sign of disease problems, call your local veterinarian. Don't wait until a general outbreak occurs.

TAIL BITING IN PIGS

Many producers raising pigs in confinement have experienced the problem of tail biting among pigs. In some instances, the problem has become very serious resulting in severe infections and even death of pigs.

Many causes of tail biting have been given: lack of exercise, boredom, nutri-

tional deficiencies, anemia, overcrowding, lack of adequate feeder and waterer space, and arrangement of feeders and waterers within the pen.

What can be done to prevent tail biting or to control it once it gets started? Once again, many different ideas have been proposed. Some producers will obtain good results with one practice, whereas another producer using the same practice will not. The following practices have been reported by hog producers as being effective in controlling or preventing tail biting:

1. Docking tails at birth. If tail biting is a consistent problem, this is probably the best preventive. Sometimes, with the tails gone, pigs will start chewing ears; however, most times, docking tails at birth eliminates the problem. Tails should be removed close to the body shortly after birth (1 to 3 days). A side cutter or a dog nail clipper can be used. Swab the wound with iodine or another disinfectant to prevent infection.

2. Remove the pig that is doing the biting. Often, it is only one pig in the pen that is causing the trouble. Watch for it and remove it.

3. Keep pigs sorted by size and avoid mixing different pens of pigs together.

4. Don't crowd hogs. Provide adequate floor space (8 to 10 square feet for market weight pigs), feeder space (for market weight pigs, 3 to 4 pigs per self-feeder hole or if hand feeding, 1-foot trough space), and waterer space (for automatic waterer, 20 pigs per cup or if hand watering, 1-foot trough space per pig).

5. Keep pigs comfortable. During hot weather, use sprays, etc., to keep pigs cool.

6. Place something in the pen to occupy the pig. Coarse gravel, old bowling balls; hanging used tires or short pieces of chain from the ceiling; placing used paper bags in the pen—all these have been reported by producers as ways of preventing tail biting.

HERD HEALTH

Compared with the farrowing and weaning period, the growing-finishing period should present a minimum of health problems. The most practical and economical approach to disease control is prevention rather than treatment. Under confinement rearing where there is normally a concentration of large numbers of pigs in a relatively small area, preventive programs take on increased importance. Generally, the incidence of disease problems increases with an increasing concentration of hogs in an area.

There is no substitute for sanitation in swine production. Time spent in developing and following a sound sanitation program will return additional dollars in hog profits. A good swine sanitation program will consider the following:

1. Disinfectants do not destroy disease-causing organisms unless they come in contact with the organisms. Before any disinfectant can do the job, all dirt and filth must be removed. The use of high-pressure air or steam will greatly assist in dirt removal.

2. Adequate time should be allowed for disinfectants to work. None acts instantly.

3. Daily removal of manure from pens will greatly assist in a sanitation program. Manure removal should include an adequate system of disposal.

4. Effectiveness of disinfectants will generally be increased through heating, rather than by applying them cold.

5. Cracks and crevices in floors, troughs, etc., should receive particular at-

tention. In some instances, it may be advisable to make repairs.

6. Keep floors dry for young pigs.

7. Equipment, particularly waterers, should be kept clean.

8. Dead animals and contaminated bedding should be disposed of by burning them completely or by burying them deep–at least 6 feet, covered with lime.

9. Sunlight is a good germ killer. Pens should be constructed so that all parts of the pen will receive some sun during the day. It is advisable to allow some distance between buildings rather than to have the entire operation under one roof. It is particularly important to have the farrowing unit separated from the market hog facilities.

10. There is no satisfactory method to sanitize a dirt lot. If a disease problem exists, clear the surface dirt, cover with lime and turn the dirt over at least 8 inches. Depending upon specific advice of the veterinarian, lots should be allowed to remain idle at least two months.

11. The effect of any sanitation program will be lost if diseased animals are brought into the facilities. Newly introduced stock should be isolated in separate facilities for 30 days before being introduced.

12. Sick pigs should always be isolated from healthy animals.

DISINFECTANTS COMMONLY USED IN A SANITATION PROGRAM

Hot Lye Solutions

For general use, mix 1 pound of lye to 10 gallons of water. For brucellosis cleanup, a 2-percent lye solution should be used (one 13-ounce can in 5 gallons water). Since over 90 percent of lye is sodium hydroxide, it is an effective disinfectant. It will kill most germs, except the tubercle bacillus. Lye solution is most effective when used hot. Concentrated lye is a caustic poison, so avoid contact with the skin. Keep a bottle of vinegar available to neutralize any solution that may get on the skin.

Sodium Carbonate (Washing Soda or Soda Ash)

For brucellosis cleanup, apply a 4-percent soda ash solution (1 pound sodium carbonate in 3 gallons water). Solution should be heated to enhance action.

Saponated Solution of Cresol

Saponated solution of cresol is an effective disinfectant but it is not easily dissolved in water, particularly hard water. It is commonly used in a 2- or 3-percent solution.

Sodium Orthophenylphenate

Sodium orthophenylphenate is a proven disinfectant which is not highly poisonous and is soluble in water. It is usually used in a 1-percent solution and should be used hot.

Quaternary Ammonium Compounds

The quaternary ammonium compounds may be used for disinfecting instruments (for castration, etc.) but they are generally not recommended for cleaning buildings and equipment.

Chlorinated Detergents

An example of a chlorinated detergent for cleaning is Breakthrough.

Steam

Steam is particularly effective when combined with a recommended disinfectant. To be effective as a sanitizer when

used alone, steam must be applied directly through a nozzle at close range for several minutes on one spot.

FLY CONTROL

With urbanization, particularly on Oahu, fly control around swine units is becoming increasingly important.

Two steps are needed to control flies in confinement rearing units:

1. Sanitation. Keep breeding areas clean. A favorite breeding medium is manure. It takes only a handful of rotting or fermenting organic matter to hatch out 1,000 flies. Feeding floors and pens and the area around the garbage cooker should be kept as clean as possible. In many local swine operations sources of fly breeding are found in the drainage ditch running from the pens to the waste disposal lagoon, or the waste disposal area itself. This presents a serious sanitation problem. Remember, unless breeding places are eliminated, flies can multiply faster than insecticides can control them.

2. Chemicals. With the open-type buildings common in Hawaii swine operations, residual sprays and baits are required for fly control. Sprays can be applied inside and outside buildings where flies land—walls, ceilings, fences, etc. In using an insecticide, it is important not to contaminate animal feed or water. As a precautionary measure, small pigs should be removed from areas to be sprayed.

Materials used as surface and residual sprays are dichlorvos (Vapona), dimethoate (Cygon), ronnel (Korlan), and malathion.

Fly baits are useful along with residual sprays where sanitation is poor. Apply baits to ground surfaces and places where pigs cannot get at them. Do not get them into feed or water supplies.

Where manure cannot be removed frequently, emegrency treatments of the manure to kill the maggots before they can develop into flies should be practiced. Materials to use include diazinon, dimethoate (Cygon), and ronnel (Korlan).

PARASITE CONTROL

External and internal parasites are common health problems encountered with growing-finishing pigs. Pigs should be observed and inspected for the presence of external parasites and treated accordingly. The hog louse and the sarcoptic mange mite are the two external parasites of principal concern to the hog producer. These parasites cause irritation to the animal, poor growth, and general unthriftiness. It is believed that hog lice carry swine influenza and swine pox.

External parasite control materials are readily available on the market. Preventive and control measures may consist of sprays, dips or dusts. When applying insecticides, the entire body surface, including the ears, should be covered. All animals should be treated at the same time, otherwise reinfestation may occur. Usually it is advisable to follow the first treatment with a second application 10 to 14 days later to kill the later-hatching parasites. A spray or a dip will penetrate mange lesions if treated animals are kept out of the sun and wind for a few hours to allow slow drying. Some insecticides are deposited in the tissue of the animal in varying degrees. In such instances, it will be necessary to allow a waiting period between treatment and marketing to eliminate possible off-flavors and residues in the meat. Table 14 lists recommended insecticides for external parasite control.

Under complete confinement rearing, internal parasites normally do not present a problem. However, under combination

Table 14. Insecticides recommended for swine lice control[1]

Insecticide	Method of application	Safety restrictions
Carbaryl	Spray thoroughly. Repeat as needed.	1. Do not treat sick animals. 2. Do not treat animals less than 3 months old with Coumaphos. Spray animals 3 to 6 months old only lightly. Do not use with synergized pyrethrins, allethrin, or synergist. Do not spray animals for 10 days before or after exposure to disease, shipping, or weaning. Do not apply Coumaphos in conjunction with oral drenches or other medications, such as phenothiazine or with other organic phosphates. 3. Do not dip animals less than 3 months old in Dioxathion. 4. Do not reapply Dioxathion or Ronnel within 2 weeks. Withdraw beddings treated with Ronnel 14 days before slaughter of swine. 5. Do not apply Ciodrin more often than once a week. 6. Do not use Malathion on animals less than 1 month old. 7. Do not apply Carbaryl more often than once every 4 days. 8. Avoid contamination of feed and water. 9. Minimum days from last application to slaughter: Carbaryl–7 days DDT–30 days Lindane–30 days (dust and sprays); 60 days (dip) Ronnel–42 days (when wettable powder or emulsifiable concentrate used); 14 days (when granules used) Toxaphene–28 days 10. Do not apply Ronnel to animals receiving organic phosphate treatment from any other source. 11. Do not treat young animals with dips or sprays containing more than 0.03 percent Lindane. Do not dip, spray, or dust animals less than 3 months old with Lindane. 12. Do not use toxaphene on animals less than 3 months old.
Ciodrin	Spray thoroughly. Repeat once a week or as necessary.	
Coumaphos DDT Dioxathion Lindane Malathion Ronnel (Korlan) Methoxychlor	Immerse, spray, or dust thoroughly. Use Lindane dusts and DDT dusts and sprays only once, but repeat other treatments after 2 to 3 weeks if needed.	
Toxaphene	Spray thoroughly. Repeat after 2 to 3 weeks if needed.	

[1] From Agriculture Handbook No. 331, U. S. Department of Agriculture, 1968. NOTE: Insecticides can be poisonous. Follow directions carefully and heed all precautions on the container label.

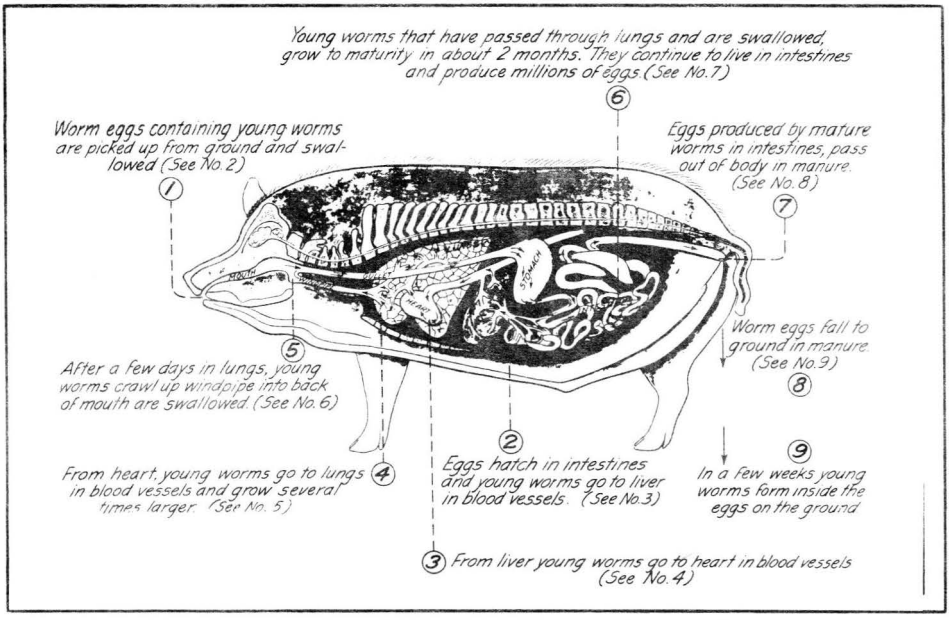


Figure 5. Roundworm cycle (from U. S. D. A. Farmer's Bulletin No. 1787).

dirt lot and confinement rearing or in pasture operations, a systematic worming program is warranted. When selecting a wormer for hogs, effectiveness of the product, method of administration, safety to animals, and cost of administration should all be considered. It is important to work closely with the local veterinarian to ensure proper diagnosis of the specific internal parasite.

Several worming compounds are available on the market. Piperazine compounds have commonly been used the past few years to combat the large roundworm or ascarid (Figure 5). These compounds are active against other parasites in swine, principally the nodular worm. Piperazine compounds can be mixed in dry feed or drinking water. They do not kill worms but they paralyze them to facilitate their removal from the intestine. The outstanding feature of piperazine is its great margin of safety.

Hygromycin B is an antibiotic that removes from pigs ascarids and, to some extent, whipworm and nodular worms. The action of hygromycin against worms is cumulative and the expulsion of ascarids, so commonly observed following piperazine treatment, is not observed. Hygromycin is normally added to the complete feed which is fed regularly over a period of time. Although it is safe to the animal, it does tend to increase the incidence of deafness in pigs if they are left on medication for a long time. Normally, it is recommended that hygromycin be discontinued after the pigs have reached 100 to 125 pounds. The newest group of wormers are the organic phosphates (e.g., Atgard V). They are effective and recommended for the removal of ascarids, whipworms, and nodular worms. They have a smaller margin of safety than other worming compounds. They may be mixed in the ration shortly before use. Pro-

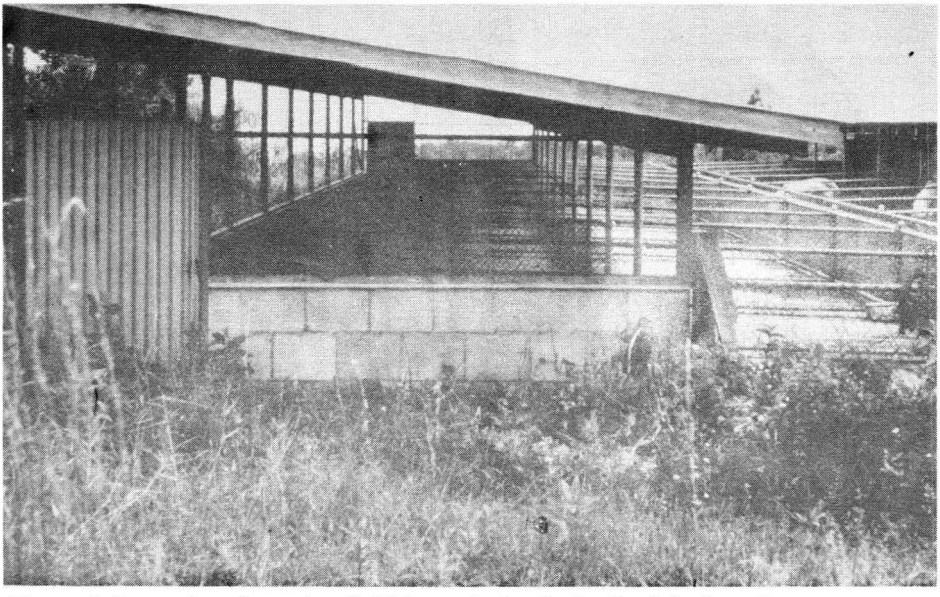


Figure 6. Examples of growing-finishing units (grain feeding) for hot climate.

longed storage of medicated feed should be avoided as it lowers the anthelmintic efficiency.

Many other disease problems can occur with growing-finishing swine, but no attempt will be made to cover these. Through sound management and feeding programs and with the cooperation of the local veterinarian, the swine producer himself can minimize inefficiency due to disease.

GROWING-FINISHING FACILITIES FOR CONFINEMENT REARING

Building requirements for growing-finishing pigs are not quite as critical as for pigs during the farrowing to weaning period. The strict environmental control needed for the baby pig in order to prevent drafts, cold temperatures, cold floors, dampness, etc., is not needed as much for the larger, older pig. As the animal increases in weight, the optimum temperature required to obtain maximum performance decreases. For the growing-finishing pigs, the optimum temperature is in the range of 60 to 70°F. Humidity affects the severity of the effect of temperature on the animal. The pig can withstand higher temperatures if the relative humidity is low. High temperature combined with high relative humidity has a marked depressive effect on the growing pig. Consequently, in warm climates, keeping the animals cool becomes of prime importance. Buildings should be so designed to provide a maximum of coolness, but they should also provide protection against inclement weather such as high winds and rainfall (Figure 6).

Building arrangements for pigs from weaning to market generally are of two types. The first consists of a nursery unit and a growing-finishing unit, the one separated from the other. Pigs are moved from the farrowing area at weaning into

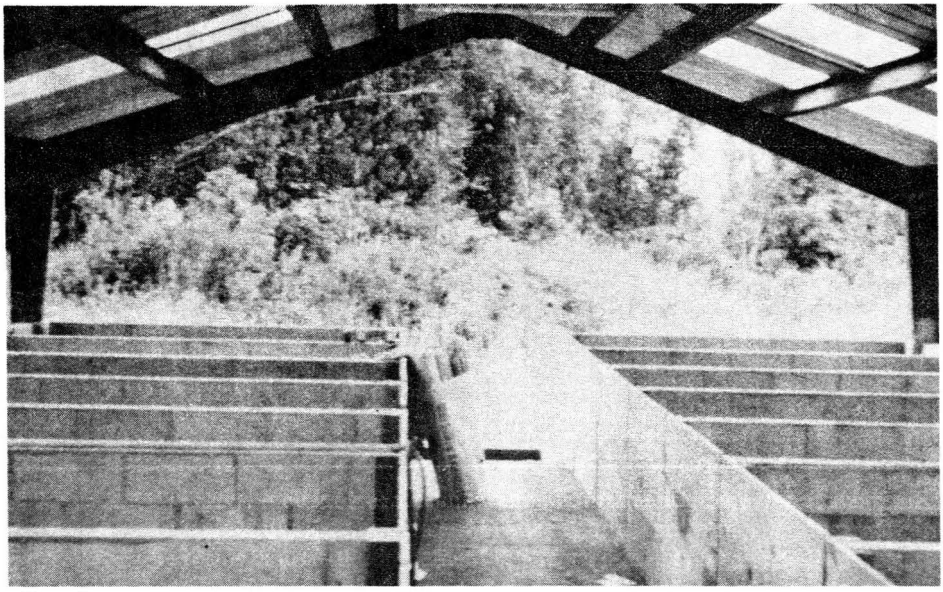


Figure 7. Nursery unit.

a nursery area for a period of time and then to the growing-finishing unit. The second consists of a growing-finishing unit only. Pigs are moved directly from the farrowing area at weaning to the growing-finishing area.

Where early weaning is being practiced (under 4 weeks), providing the intermediate nursery unit or area is advisable. The openness of market hog units may not provide the necessary protection to the small pig, particularly during the colder, wetter part of the year. The nursery unit can be designed to adequately control the environment and to maintain pigs in smaller groups (Figures 7, 8, and 9).

Major factors to consider in a growing-finishing layout should include the following:

1. Function. Besides being capable of modifying or controlling environmental effects, buildings should be laid out to result in maximum labor efficiency. Units should be designed to be safe for both the animal and the operator. They should be designed to promote sanitation and disease prevention and to permit efficient waste disposal (Figure 10). Interiors of buildings should be relatively flexible so that future changes can be made at reasonable cost in case there are changes in feeding or management systems.

2. Pen Arrangement. For efficiency of labor, a central alley for feeding and working with the pens on either side of the alley is probably the best arrangement (Figures 11 and 12). Feeding and washing can be done systematically from the central alley without having to get into the pen. This is an added disease preventative.

3. Pen Size. Small groups of pigs in a pen will generally perform better than large groups. There is the additional advantage that the animals can be marketed more as a group, thus permitting the use of the floor space for the next group of pigs. Large pens with many animals may

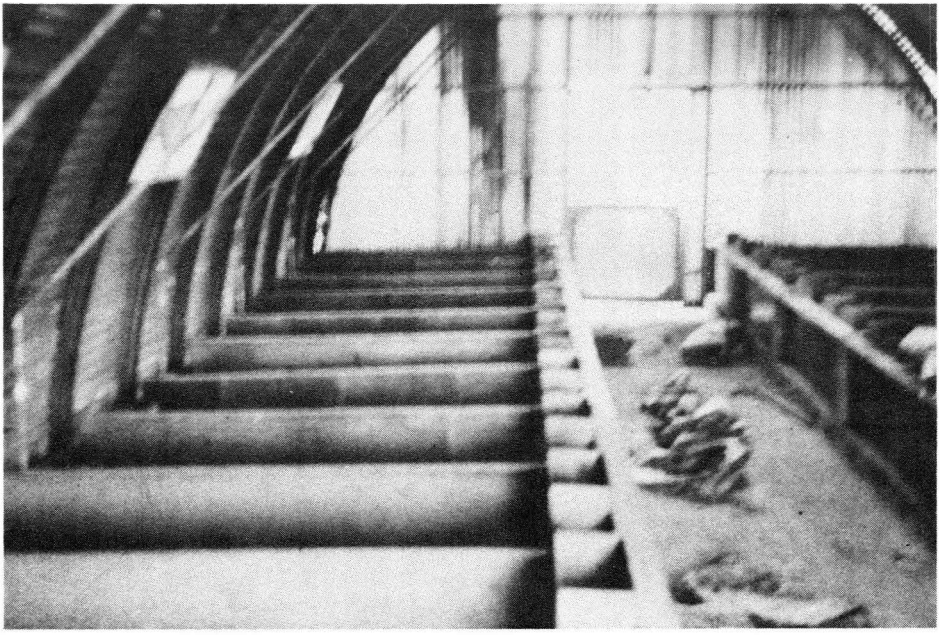
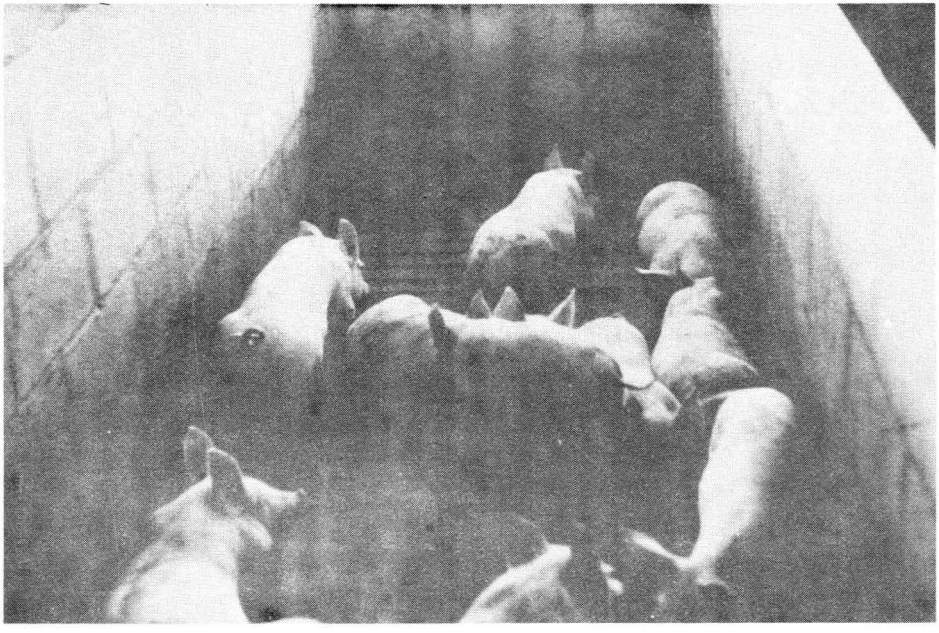


Figure 8. Quonset building used as nursery unit.

Figure 9. Small-pig unit with partially slotted floors.



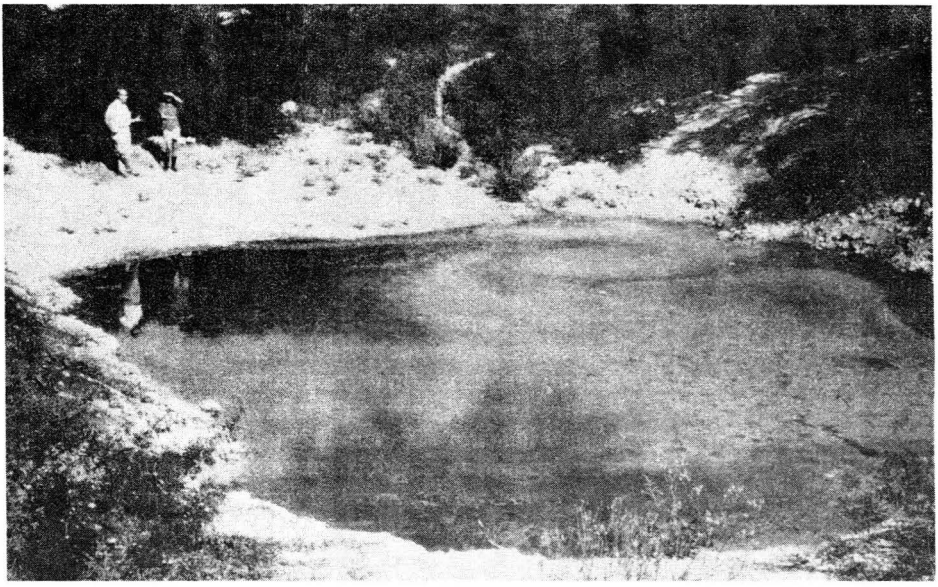


Figure 10. Waste disposal lagoon.

require several weeks of "topping off" before all the pigs are marketed. Thus toward the end of the "topping off" period, the large floor space is tied up with a few pigs. Small groups of pigs permit better regulation of ration changes to fit the needs of all the pigs. In confinement rearing, groups of early-weaned pigs (under 4 weeks) should not exceed 8 to 10 per group. Growing-finishing pigs should be maintained in groups not to exceed 25 to 30 pigs per group. The exact pen arrangement and size should be such that there is a minimum of moving and re-sorting of animals. Consistent re-sorting and mixing tends to have a depressing effect on performance, and the fighting that usually results from mixing can lead to more foot and leg injuries where slotted floors are being used.

4. Pen Shape. The use of long, narrow pens aids in cleanliness. Compared with a square pen of equal floor space area, this type of pen results in better separation of the feeding-sleeping area and the dunging area. In garbage feeding operations, because of the space required for feeding troughs, the pen length usually parallels the central alley, with the low end of the floor at the feed trough end (Figures 13 and 14). Adequate floor slope is important in order to have as dry a floor surface as possible.

5. Floor Area. In confinement rearing up to market weight, 8 to 9 square feet of floor space per pig should be allowed where slotted floor is used and 10 to 12 square feet per pig where solid floor is used. During hot weather, slightly more space should be allowed per animal.

6. Type of Floor. Two kinds of floor surfaces may be used, solid or slotted (partial or complete) (Figures 15 and 16). Slotted floors are generally preferred because of sanitation and reduced labor requirements for cleaning. Partially slotted floors (one-fourth of the floor surface area slotted) have an advantage over fully

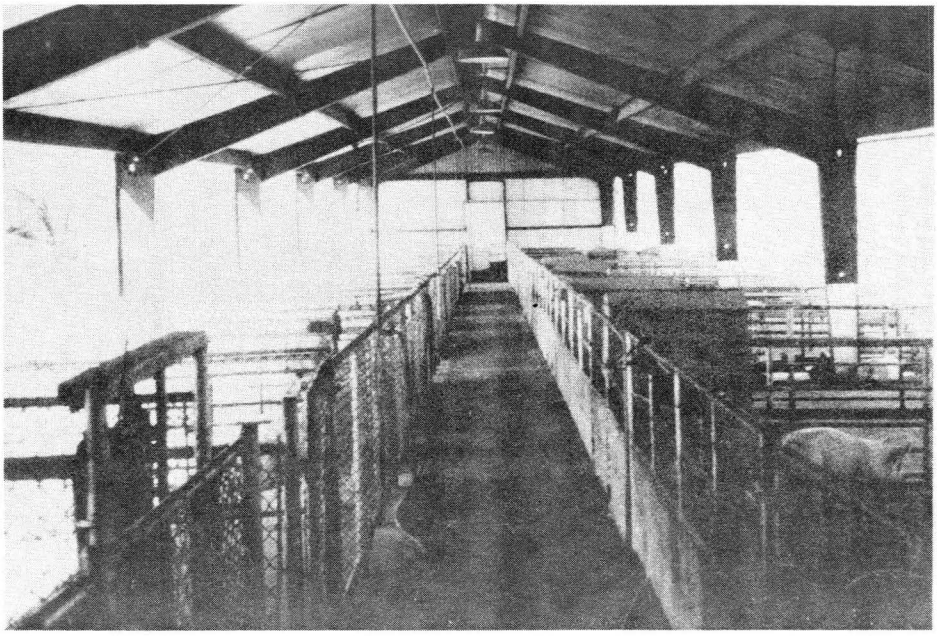
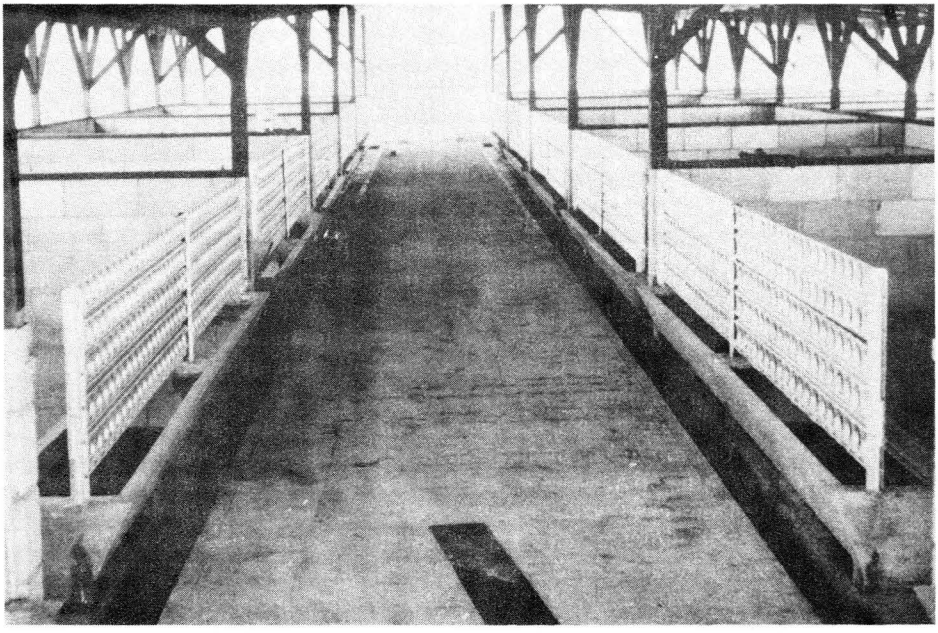
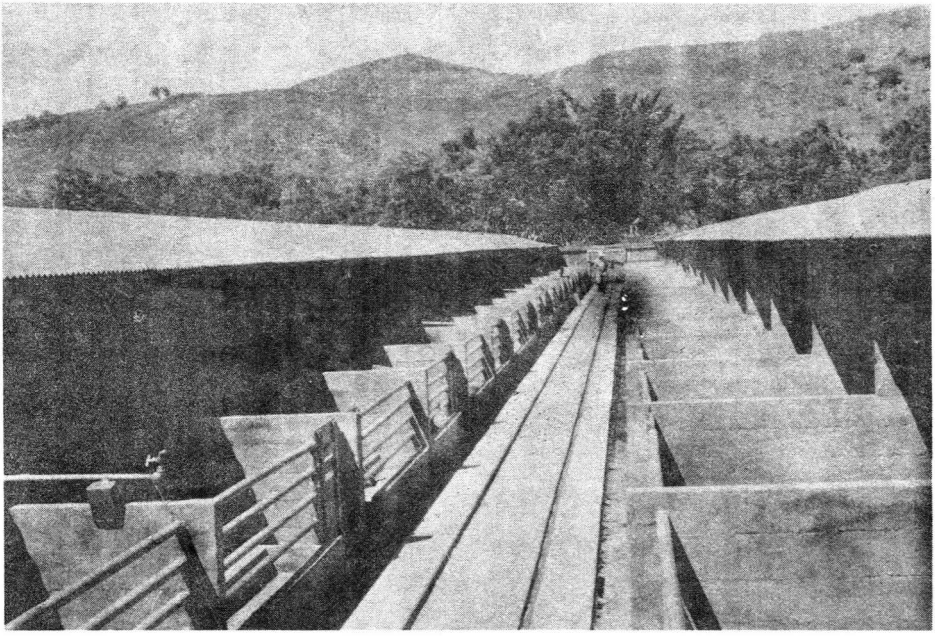


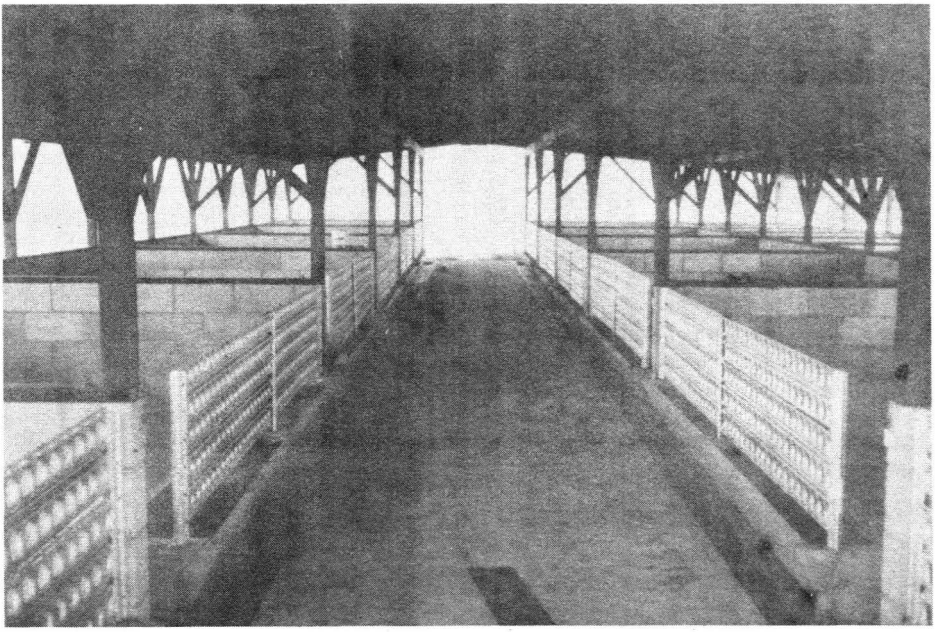
Figure 11. Market hog unit (grain feeding).

Figure 12. Market hog unit (garbage feeding).





Figures 13 and 14. Garbage feeding operations.



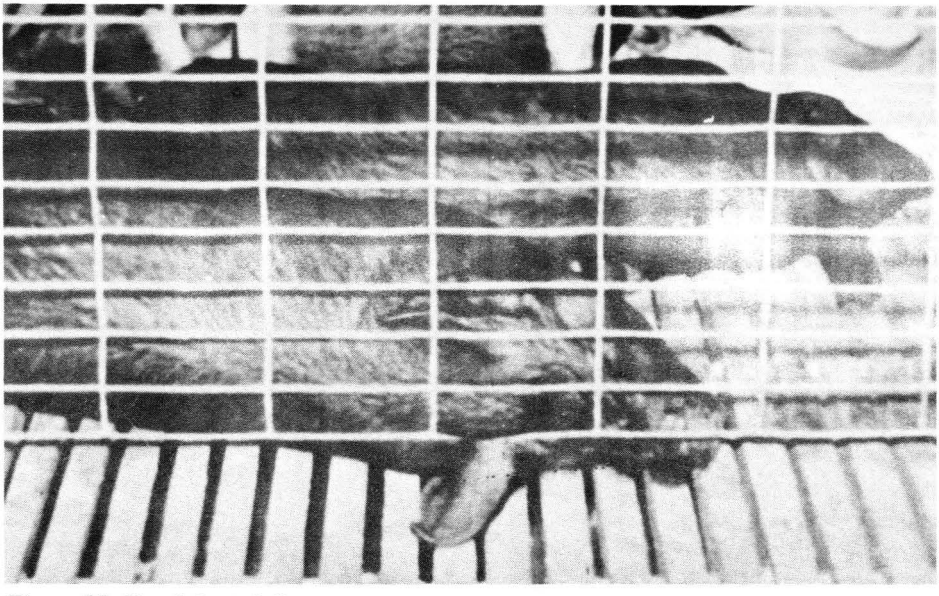


Figure 15. Total slotted floor.

slotted floors in that less feed is lost and the floor surface is cooler during warm weather, although they are not quite as clean as fully slotted floors. (See University of Hawaii Cooperative Extension Service Circular 413, *Slotted Floors for Swine.)* If solid concrete floors are used, there should be a minimum slope of ½ inch per foot. This permits quick runoff so the floor remains dry. Solid concrete floors should have a non-slip surface.

7. Pen dividers, feeders, gates, etc., should all be made of materials that the pigs cannot eat or chew. Solid pen dividers prevent drafts and help prevent disease spread due to pig-to-pig contact from one pen to the other. However, during hot weather, solid pen dividers may not permit maximum air movement.

8. Waterer Location. To help regulate dunging, locate the waterer at the low end of the pen opposite the feeding and sleeping area. Allow one cup per 20 pigs and place the waterer 10 feet from the feeder to prevent clogging.

9. Roof Area. In warm, dry areas, it is sufficient to have one-half to two-thirds of the floor area covered by roof. In high-rainfall, windy areas, it is advantageous to have the entire floor area covered by roof.

Assistance on construction of swine buildings and equipment may be obtained from your County Extension Agent and from the following publications: U.S.D.A. Miscellaneous Publication No. 744, *Hog Houses;* U.S.D.A. Farmers' Bulletin 2191, *Hot-Lot Equipment;* Mid-West Planning Service 8, *Swine Equipment Plans and Housing Needs.*

MARKETING

Much time, effort, and money are spent in raising the pig to market weight. To reduce the market value of the animal through sloppy handling and shipping

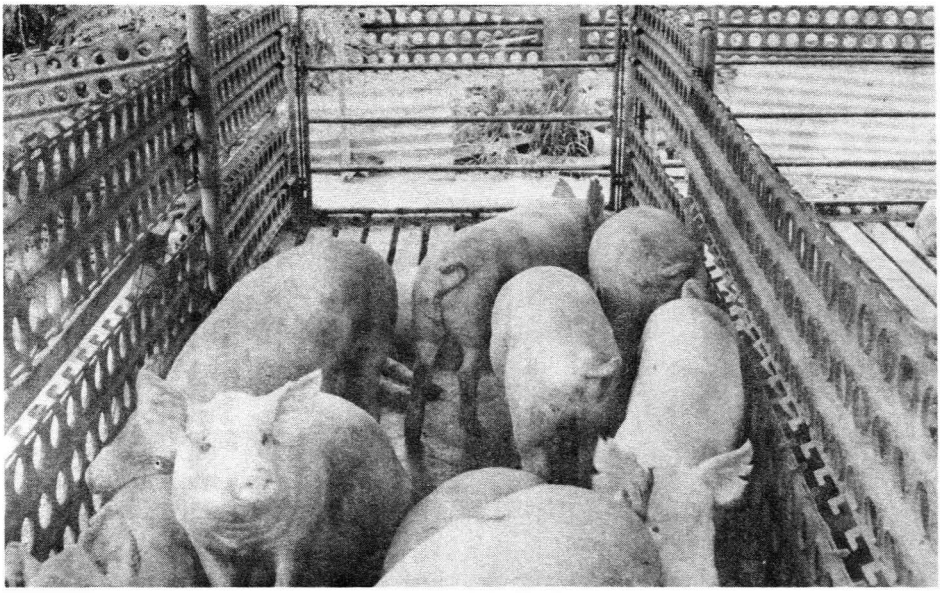


Figure 16. Partially slotted floors.

methods from farm to market is poor practice. Extra money can be pocketed each year by proper handling. Losses from injured animals and damaged meat due to improper handling can be high. Safe and common sense handling of animals can avoid this. Follow these tips:

1. Avoid twisting, confusing handling routes. Use straight-line patterns. Clear the way of obstacles that can injure animals.

2. Avoid "persuader" objects–hot-shots, canes, whips–that will frighten or excite animals. Use canvas slappers and hand hurdles.

3. Never overcrowd a pen alleyway or loading chute. You can move more animals quietly than by jamming or forcing them.

4. Loading chutes and truck racks should be free of sharp objects, nails, etc. (Figure 17).

5. Provide good footing on truck beds. Steel decks can become slippery as well as hot if not covered.

6. Inter-island barge transportation of animals should include shade, water, and suitable bedding material. On hot days, hogs delivered by truck should have shade en route.

7. Avoid crowding the animals on either truck or barge. A market weight hog should be allowed about 4 square feet of floor space.

8. Partition mixed loads of animals. Sows should be partitioned from young animals.

9. Don't be a truck "hot-rodder." Drive trucks carefully. Turn corners slowly, slow down on curves, and start and stop gently.

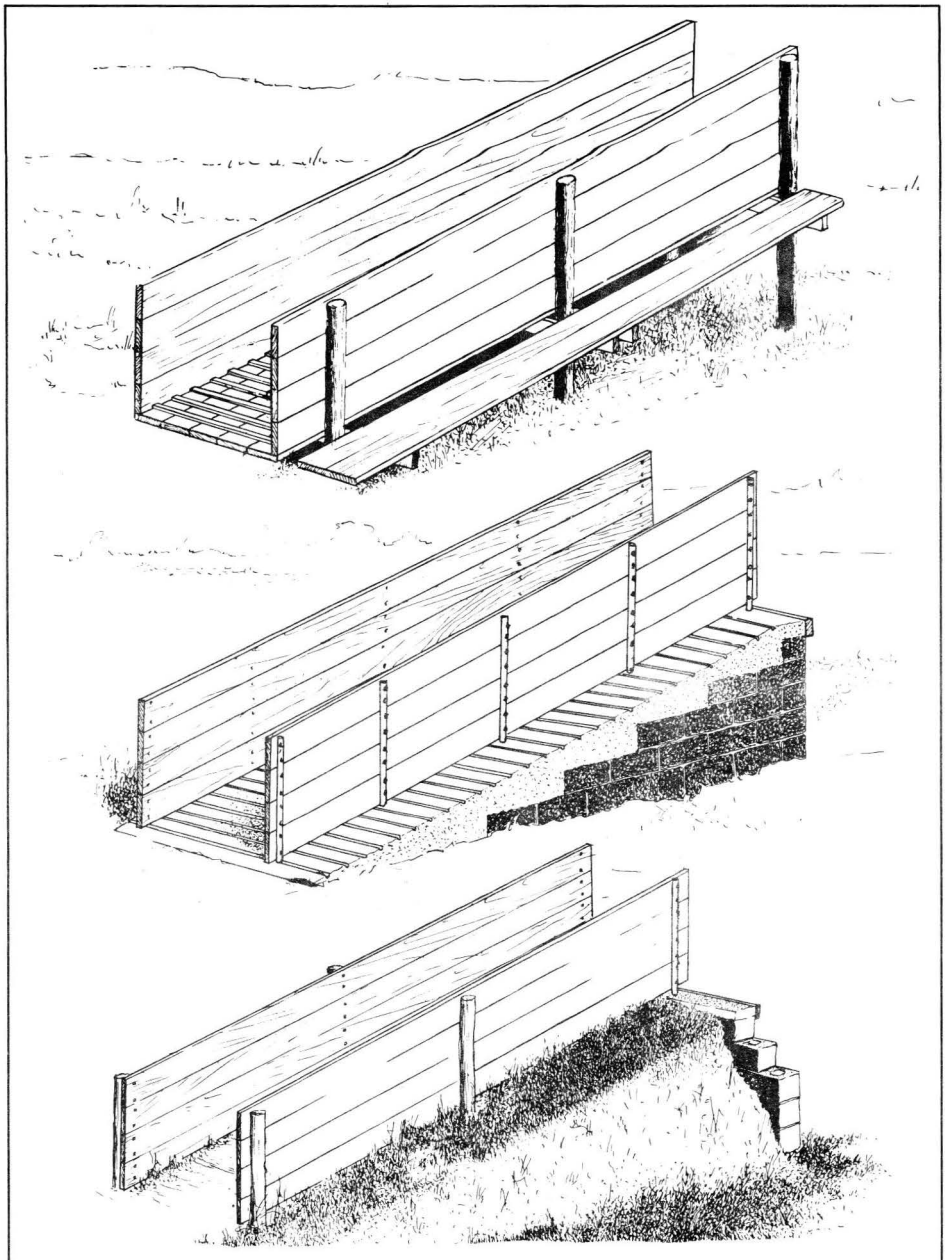


Figure 17. Three methods of building a permanent-type loading chute (from U. S. D. A. Farmer's Bulletin No. 2192).

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